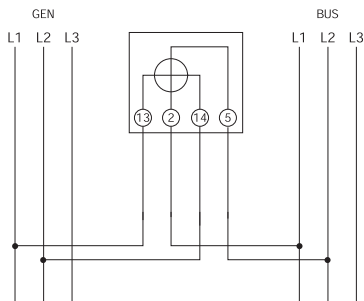


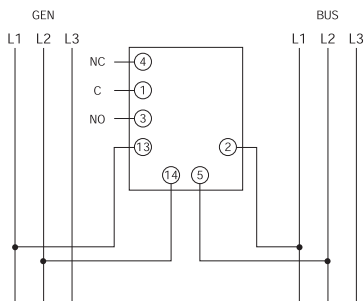
# LED SYNCHROSCOPE



## Connections 360° LED Synchroscope



## 360° LED Synchroscope and Synchro Check Relay



## 360° LED Synchroscope and Synchro Check Relay

Where manual paralleling of two AC systems is desired, the frequency of both systems can be monitored by an LED synchroscope. The systems are synchronised when the green LED is lit in the 12 o'clock position. The instrument is rated for continuous operation and connection. For the semi-automatic paralleling of two AC systems, the voltage, phase displacement and the frequency of both systems can be monitored by this LED synchroscope and synchro check relay. Controls for voltage, phase angle, and time delay are provided. The systems are synchronised when the green triangular LEDs are lit together with the GEN/BUS green LEDs. A dead bus option is also available.

### Specifications

Ratings voltage:	63.5, 110, 120, 220, 230, 240, 380, 400, 415, 440, 480V 110/120V (115V nominal) 220/240V (230V nominal) 380/480V (430V nominal) Volts AC or via VT
Frequency:	40/65Hz
Burden at 50Hz:	4VA maximum Suitable for 1 or 3-phase systems
Safety:	IEC1010-1 (300V AC RMS installation degree 2)
Dielectric:	4kV rms for 1 minute
Isolation:	BUS/GEN/RELAY
Vibration:	To Lloyds shipping specification
*Phase difference:	+0-20°, +2%
*Voltage difference:	+0-20%, +/-2% 0-10% for models G and H
*Time delay:	0-2.5 seconds +10%
*Accuracy:	Synchronisation at T.DC is +1°

\*Only for the 360° LED synchroscope and synchro check relay.

### Dimensions

Bezel size mm	96	96	96
Scale length mm	360° LED	360° LED	360° LED
3- or 4-wire 40-65Hz	Synchroscope	Synchroscope and synchro check	Synchroscope and synchro check relay (dead bus)

### Product codes

110/120V	-	244-14GG-POBX	244-14HG-POBX
220/240V	-	244-14GG-R5BX	244-14HG-R5BX
380/480V	-	244-14GG-RUBX	244-14HG-RUBX
63.5V	244-14AG-NXYY	244-14LG-NXBX	244-14DG-NXBX
110V	244-14AG-PMYY	244-14LG-PMBX	244-14DG-PMBX
220V	244-14AG-R4YY	244-14LG-R4BX	244-14DG-R4BX
230V	244-14AG-RQYY	244-14LG-RQBX	244-14DG-RQBX
240V	244-14AG-RRYY	244-14LG-RRBX	244-14DG-RRBX
380V	244-14AG-RUY Y	244-14LG-RUBX	244-14DG-RUBX
400V	244-14AG-SCYY	244-14LG-SCBX	244-14DG-SCBX
415V	244-14AG-SBYY	244-14LG-SBBX	244-14DG-SBBX
440V	244-14AG-SHYY	244-14LG-SHBX	244-14DG-SHBX
480V	244-14AG-SEYY	244-14LG-SEBX	244-14DG-SEBX

For the 244-14L and 244-14D models, the generator voltage is compared to the nominal input (bus) voltage specified at time of ordering. For the 244-14G and 244-14H models, the generator voltage is compared to the measured bus voltage.

# SYNCHROSCOPE



## Features

- Typically used to measure between Busbar and Generator
- Available as LED indicator only, LED indicator with LCD display, LED indicator with synchro check relay, LED indicator with LCD display and synchro check relay

## Benefits

- Supports damage prevention on expensive assets
- Simple synchronisation conditions setting
- High visibility
- Terminal cover included
- Low self consumption
- Up to five meters in one unit

## Applications

- Used on manual and semi-automatic synchronising applications
- AC switchgears, panels and distribution boards
- Generator sets

## Construction

- Instruments are microprocessor based
- Slot in screw fixing

## Standards

- CE marked
- BV approved

## General Specification

### Synchronising functions

- Voltage difference setting ( $\Delta U$ ) - 1.5
- Accuracy - +/- 2.5%
- Phase difference setting - 2 ... 20° el.
- Accuracy - +/- 3° el.
- Time delay synchronisation - 0.1 ... 1 s.
- Accuracy - +/- 10%
- Synchronisation pulse duration - 300 ms
- Accuracy - +/- 30 ms
- Nominal frequency range - 45/65Hz
- Output relay specification - 250V, 6A, 50Hz, 1500 VA
- Voltage burden - <4 VA
- Overload - 1.2 x Un permanently, 2 x Un for 3s

### LED functions

- Resolution  $\Delta \phi$  display - 20° el.
- Magnified resolution range - +/- 15° el.
- Magnified resolution - 5° el.
- Accuracy at  $\Delta \phi = 0$  - +/- 3° el.

### LCD functions

- Accuracy voltage display - +/- 1.5%
- Accuracy frequency display - +/- 0.5%
- Phase difference accuracy Ugen to Ubb - +/- 3° el.

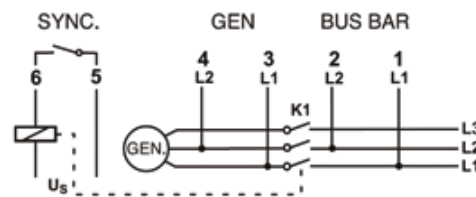
## Product Codes

Bezel size (mm)	96	96	96
	M244-14A-S LED only	M244-14L-S LED & synchro check relay	M244-14D-S LED & synchro check relay with deadbus option
Bezel size (mm)	96	96	96
		M244-14M-S LED & synchro check relay & LCD	M244-14E-S LED & synchro check relay with deadbus option & LCD display
<b>Standard input ranges</b>			
Voltage	100V L/L, 110V L/L, 400V L/L, 415 V L/L, 440V L/L		

## Order data/examples

- 1) Select type: M244-14M-S,
- 2) Specify input voltage: 415V,
- 3) Specify display or output: Relay output,
- 4) Specify frequency: 45-65Hz,
- 5) Specify functional description: Output duration 300ms

## Connection Diagrams



# POWER



## Features

- Indicates active power of electrical systems
- Several voltage ranges available
- Current connection via “through hole” CT on the instrument. No need to interrupt wiring from CT

## Benefits

- Easy to operate
- High visibility
- Terminal cover included
- Low self consumption
- Internal power supply from voltage input

## Applications

- AC switchgears, panels and distribution boards
- Control boards
- Generator sets

## Construction

- Instruments operate on a fast sampling method of input quantities (current and voltage) of the connected phases
- Meters include “through hole” CT connection, voltage dividers, internal microprocessor and power supply unit
- Slot in screw fixing

## Standards

- CE marked
- BV approved

## Order data/examples

### Single-phase

- 1) Select type: M244-210,
- 2) Specify input voltage and CT ratio: 230V L-N, 50/5A,
- 3) Specify scaling: 0-10 kW,
- 4) Specify frequency: 50/60Hz,

### 3-phase 4-wire balanced or 3-phase 4-wire unbalanced

- 1) Select type: M244-21D,
- 2) Specify input voltage and CT ratio: 230 V L-N, 400/5A,
- 3) Specify scaling: 0-250 kW,
- 4) Specify frequency: 50/60Hz

## Wattmeters

### General Specification

- Accuracy class - 1.5
- Maximum continuous overload -  $3 \times I_n$ ,  $1.5 \times U_n$
- Maximum short duration overload -  $25 \times I_n$  for 30 seconds,  $50 \times I_n$  for 1 second,  $2 \times U_n$  for 10 seconds
- Voltage burden -  $<0.1V_A$  per phase
- Current burden -  $<0.1V_A$  per phase
- Frequency - 50/60 Hz

### Product Codes

Bezel size (mm)	96	96	96	96	96
Scale length (mm)	95	95	95	95	95
Wattmeter 90°	M244-210 single-phase	M244-211 3P/3W balanced	M244-21C 3P/4W balanced	M244-213 3P/3W unbalanced	M244-214 3P/4W unbalanced
Bezel size (mm)	96	96	96	96	96
Scale Length (mm)	135	135	135	135	135
Wattmeter 240°	M244-215 single-phase	M244-216 3P/3W balanced	M244-21D 3P/4W balanced	M244-218 3P/3W unbalanced	M244-219 3P/4W unbalanced
<b>Standard input ranges</b>					
Single-phase, 3P/4W balanced, 3P/4W unbalanced	57.7V L-N/1A, 57.7V L-N/5A, 63.5V L-N/1A, 63.5V L-N/5A, 230V L-N/1A, 230V L-N/5A, 240V -N/1A, 240V L-N/5A, 254V L-N/1A, 254V L-N/5A,				
3P/3W balanced, 3P/3W unbalanced	100V L-L/1A, 100V L-L/5A, 110V L-L/1A, 110V L-L/5A, 400V L-L/1A, 400V L-L/5A, 415V L-L/1A, 415V L-L/5A, 440V L-L/1A, 440V L-L/5A				

### Calculation of end scale value

End scale value is calculated using the formula below, where correct voltage must be selected (either L-N or L-L), depending on the electrical system and the type of meter used. Scale factor, e.g. the relation between end scale value and nominal apparent power ( $\cos\phi = 1$ ) must be between 0.6 to 1.2. It is recommended selecting the scale value from 1 - 1.2 - 1.25 - 1.5 - 2 - 2.5 - 3 - 4 - 5 - 6 - 7.5 - 8 (and their decades) closest to the calculated result.

Electrical system	Formula	Example	End scale value to choose (considering 0,6 to 1.2 x S)
Single-phase, direct voltage connection	$P = U(L-N) \times I_p \times \cos \phi$	$P = 230V \times 50A \times 0.9 = 10350 W = 10.35 kW$	10 kW
3-phase 4-wire, direct voltage connection (balanced or unbalanced)	$P = 3 \times U(L-N) \times I_p \times \cos \phi$	$P = 3 \times 230V \times 400A \times 0.95 = 262200 W = 262,2 kW$	250 kW
3-phase 3-wire, direct voltage connection (balanced or unbalanced)	$P = 1.732 \times U(L-L) \times I_p \times \cos \phi$	$P = 1.732 \times 400V \times 1000A \times 0.9 = 623520 W = 623,52 kW$	600 kW
3-phase 4-wire, voltage connection via VT (balanced or unbalanced)	$P = 3 \times U_p(L-N) \times I_p \times \cos \phi$	$P = 3 \times 5770V \times 100A \times 0.95 = 1644450 W = 1,64445 MW$	1.5 MW
3-phase 3-wire, voltage connection via VT (balanced or unbalanced)	$P = 1.732 \times U_p(L-L) \times I_p \times \cos \phi$	$P = 1.732 \times 30000V \times 50A \times 0.9 = 2338200 W = 2,3382 MW$	2.5 MW

### 3-phase 3-wire balanced or unbalanced

- 1) Select type: M244-213,
- 2) Specify input voltage and CT ratio: 400V L-L, 1000/1A,
- 3) Specify scaling: 0-600 kW,
- 4) Specify frequency: 50/60Hz

### 3-phase 4-wire balanced or unbalanced, VT connected

- 1) Select type: M244-214,
- 2) Specify VT ratio and CT ratio: 5770/57.7V L-N, 100/5A,
- 3) Specify scaling: 0-1.5 MW,
- 4) Specify frequency: 50/60Hz

### 3-phase 3-wire balanced or unbalanced

- 1) Select type: M244-218,
- 2) Specify input VT ratio and CT ratio: 30000/110V L-L, 50/1A,
- 3) Specify scaling: 0-2.5 MW
- 4) Specify frequency: 50/60Hz



## Features

- Indicates reactive power of electrical systems
- Several voltage ranges available
- Current connection via “through hole” CT on the instrument. No need to interrupt wiring from CT

## Benefits

- Easy to operate
- High visibility
- Terminal cover included
- Low self consumption
- Internal power supply from voltage input

## Applications

- AC switchgears, panels and distribution boards
- Control boards
- Generator sets

## Construction

- Instruments operate on a fast sampling method of input quantities (current and voltage) of the connected phases.
- Meters include “through hole” CT connection, voltage dividers, internal microprocessor and power supply unit.
- Slot in screw fixing

## Standards

- CE marked
- BV approved

## Order data/examples

### Single-phase

- Select type: M244-310,
- Specify input voltage and CT ratio: 230V L-N, 50/5A,
- Specify scaling: 0-6 kvar,
- Specify frequency: 50/60Hz,

### 3-phase 4-wire balanced or 3-phase 4-wire unbalanced

- Select type: M244-31D,
- Specify input voltage and CT ratio: 230 V L-N, 400/5A,
- Specify scaling: 0-200 kvar,
- Specify frequency: 50/60Hz

## Varmeters

### General Specification

- Accuracy class - 1.5
- Maximum continuous overload -  $3 \times I_n$ ,  $1.5 \times U_n$
- Maximum short duration overload -  $25 \times I_n$  for 30 seconds,  $50 \times I_n$  for 1 second,  $2 \times U_n$  for 10 seconds
- Voltage burden -  $<0.1VA$  per phase
- Current burden -  $<0.1VA$  per phase
- Frequency - 50/60Hz

### Product Codes

Bezel size (mm)	96	96	96	96	96
Scale Length (mm)	95	95	95	95	95
Varmeter 90°	M244-310 single-phase	M244-311 3P/3W balanced	M244-31C 3P/4W balanced	M244-313 3P/3W unbalanced	M244-314 3P/4W unbalanced
Bezel size (mm)	96	96	96	96	96
Scale length (mm)	135	135	135	135	135
Varmeter 240°	M244-315 single-phase	M244-316 3P/3W balanced	M244-31D 3P/4W balanced	M244-318 3P/3W unbalanced	M244-319 3P/4W unbalanced
<b>Standard input ranges</b>					
Single-phase, 3P/4W balanced, 3P/4W unbalanced	57.7V L-N/1A, 57.7V L-N/5A, 63.5V L-N/1A, 63.5V L-N/5A, 230V L-N/1A, 230V L-N/5A, 240V L-N/1A, 240V L-N/5A, 254V L-N/1A, 254V L-N/5A				
3P/3W balanced, 3P/3W unbalanced	100V L-L/1A, 100V L-L/5A, 110V L-L/1A, 110V L-L/5A, 400V L-L/1A, 400V L-L/5A, 415V L-L/1A, 415V L-L/5A, 440V L-L/1A, 440V L-L/5A				

### Calculation of end scale value

End scale value is calculated using the formula below, where correct voltage must be selected (either L-N or L-L), depending on the electrical system and the type of meter used. Scale factor, e.g. the relation between end scale value and nominal apparent power ( $\cos\phi = 1$ ) must be between 0.6 to 1.2. It is recommended selecting the scale value from 1 - 1.2 - 1.25 - 1.5 - 2 - 2.5 - 3 - 4 - 5 - 6 - 7.5 - 8 (and their decades) closest to the calculated result.

$I_p$  = CT primary current,  $U_p$  = VT primary voltage,  $U$  = direct connected voltage,  $\sin \phi$  = power factor

Electrical system	Formula	Example	End scale value to choose (considering 0,6 to 1,2 x S)
Single-phase, direct voltage connection	$Q = U(L-N) \times I_p \times \sin \phi$	$Q = 230V \times 50A \times 0,44 = 5060 \text{ var} = 5,06 \text{ kvar}$	6 kvar
3-phase 4-wire, direct voltage connection (balanced or unbalanced)	$Q = 3 \times U(L-N) \times I_p \times \sin \phi$	$P = 3 \times 230V \times 400A \times 0,31 = 85560 \text{ var} = 85,56 \text{ kvar}$	200 kvar
3-phase 3-wire, direct voltage connection (balanced or unbalanced)	$Q = 1,732 \times U(L-L) \times I_p \times \sin \phi$	$P = 1,732 \times 400V \times 1000A \times 0,44 = 304832 \text{ var} = 304,8 \text{ kvar}$	500 kvar
3-phase 4-wire, voltage connection via VT (balanced or unbalanced)	$Q = 3 \times U_p(L-N) \times I_p \times \sin \phi$	$P = 3 \times 5770V \times 100A \times 0,199 = 344469 \text{ var} = 344,469 \text{ kvar}$	1 Mvar
3-phase 3-wire, voltage connection via VT (balanced or unbalanced)	$Q = 1,732 \times U_p(L-L) \times I_p \times \sin \phi$	$P = 1,732 \times 30000V \times 50A \times 0,44 = 1143120 \text{ var} = 1,14312 \text{ Mvar}$	2 Mvar

### 3-phase 3-wire balanced or unbalanced

- Select type: M244-313,
- Specify input voltage and CT ratio: 400V L-L, 1000/1A,
- Specify scaling: 0-500 kvar,
- Specify frequency: 50/60Hz

### 3-phase 4-wire balanced or unbalanced, VT connected

- Select type: M244-314,
- Specify VT ratio and CT ratio: 5770/57.7V L-N, 100/5A,
- Specify scaling: 0-1 Mvar,
- Specify frequency: 50/60Hz

### 3-phase 3-wire balanced or unbalanced

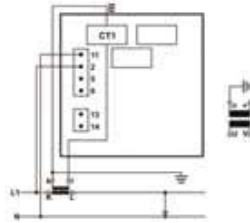
- Select type: M244-318,
- Specify input VT ratio and CT ratio: 30000/110V L-L, 50/1A,
- Specify scaling: 0-2 Mvar,
- Specify frequency: 50/60Hz



## Wiring Diagrams of Wattmeters and Varmeters

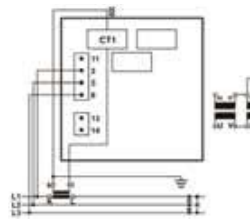
### Single-phase, direct or VT voltage connection

Wattmeter M244-210  
Wattmeter M244-215  
Varmeter M244-310  
Varmeter M244-315



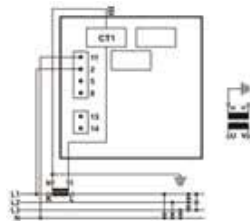
### 3-phase 3-wire balanced, direct or VT voltage connection

Wattmeter M244-211  
Wattmeter M244-216  
Varmeter M244-311  
Varmeter M244-316



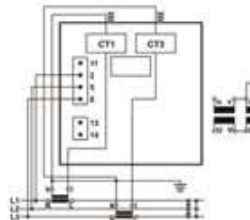
### 3-phase 4-wire balanced, direct or VT voltage connection

Wattmeter M244-21C  
Wattmeter M244-21D  
Varmeter M244-31C  
Varmeter M244-31D



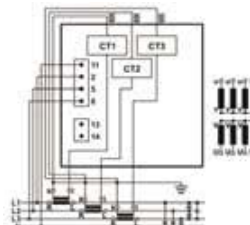
### 3-phase 3-wire unbalanced, direct or VT voltage connection

Wattmeter M244-213  
Wattmeter M244-218  
Varmeter M244-313  
Varmeter M244-318



### 3-phase 4-wire unbalanced, direct or VT voltage connection

Wattmeter M244-214  
Wattmeter M244-219  
Varmeter M244-314  
Varmeter M244-319





## Features

- Counts electrical active energy and indicates active power of electrical systems
- Several voltage ranges available
- Current connection via “through hole” CT on the instrument. No need to interrupt wiring from CT
- Pulsed output as standard

## Benefits

- High visibility
- Terminal cover included
- Low self consumption
- Separated power supply

## Applications

- AC switchgears, panels and distribution boards
- Control boards
- Generator sets

## Construction

- Instruments operate on a fast sampling method of input quantities (current and voltage) of the connected phases
- Meters include “through hole” CT connection, voltage dividers, internal microprocessor and power supply unit
- Slot in screw fixing

## Standards

- CE marked
- BV approved

## Order data/examples

### Single-phase

- Select type: M244-HWG,
- Specify input voltage and CT ratio: 230V L-N, 50/5A,
- Spec. scaling: 0-10 kW,
- Spec. frequency: 50/60Hz,
- Select pulse rate: 1p/10kWh,
- Select output: 1 pulsed output

### 3-phase 4-wire balanced or 3-phase 4-wire unbalanced

- Select type: M244-HWK,
- Specify input voltage and CT ratio: 230 V L-N, 400/5A,
- Spec. scaling: 0-250 kW,
- Spec. frequency: 50/60Hz,

## Active Energy Meter with Power Indicator

### General Specification

- Accuracy class active power meter - 1.5
- Accuracy class active energy meter - 1 to EN 62053-21
- Maximum continuous overload -  $2 \times I_n$ ,  $1.2 \times U_n$
- Nominal frequency - 50/60Hz
- Voltage burden -  $<0.1VA$  per phase
- Current burden -  $<0.1VA$  per phase
- Power supply - Various AC volts between 57.7 and 400
- Frequency - 40-65Hz
- Voltage burden -  $<3 VA$
- Pulsed output - 1 SO pulsed output with 1p/10kWh, 1p/100kWh, 1p/10MWh, 1p/100MWh. Maximum pulse rate may not exceed 33 pulses per second (1980 pulses per minute). If in doubt choose next higher value, e.g. 1p/100/kWh instead of 1p/10kWh

### Product Codes

Bezel size (mm)	96	96	96	96	96
Scale length (mm)	95	95	95	95	95
Active energy meter with Wattmeter 90°	M244-HWG single-phase	M244-HWH 3P/3W balanced	M244-HWV 3P/4W balanced	M244-HWJ 3P/3W unbalanced	M244-HWK 3P/4W unbalanced
Bezel size (mm)	96	96	96	96	96
Scale Length (mm)	135	135	135	135	135
Active energy meter with Wattmeter 240°	M244-HWB single-phase	M244-HWC 3P/3W balanced	M244-HWU 3P/4W balanced	M244-HWD 3P/3W unbalanced	M244-HWE 3P/4W unbalanced
<b>Standard input ranges</b>					
Single-phase, 3P/4W balanced & unbalanced	57.7V L-N/1A, 57.7V L-N/5A, 63.5V L-N/1A, 63.5V L-N/5A, 230V L-N/1A, 230V L-N/5A, 240V L-N/1A, 240V L-N/5A, 254V L-N/1A, 254V L-N/5A,				
3P/3W balanced & unbalanced	1100V L-L/1A, 100V L-L/5A, 110V L-L/1A, 110V L-L/5A, 400V L-L/1A, 400V L-L/5A, 415V L-L/1A, 415V L-L/5A, 440V L-L/1A, 440V L-L/5A				

### Calculation of end scale value

End scale value is calculated using the formula below, where correct voltage must be selected (either L-N or L-L), depending on the electrical system and the type of meter used. Scale factor, e.g. the relation between end scale value and nominal apparent power ( $\cos\phi = 1$ ) must be between 0.6 to 1.2. It is recommended selecting the scale value from 1 - 1.2 - 1.25 - 1.5 - 2 - 2.5 - 3 - 4 - 5 - 6 - 7.5 - 8 (and their decades) closest to the calculated result.

$I_p$  = CT primary current,  $U_p$  = VT primary voltage,  $U$  = direct connected voltage,  $\cos\phi$  = power factor

Electrical system	Formula	Example	End scale value to choose (considering 0.6 to 1.2 x S)
Single-phase, direct voltage connection	$P = U(L-N) \times I_p \times \cos\phi$	$P = 230V \times 50A \times 0.9 = 10350 W = 10.35 kW$	10 kW
3-phase 4-wire, direct voltage connection (balanced or unbalanced)	$P = 3 \times U(L-N) \times I_p \times \cos\phi$	$P = 3 \times 230V \times 400A \times 0.95 = 262200 W = 262.2 kW$	250 kW
3-phase 3-wire, direct voltage connection (balanced or unbalanced)	$P = 1.732 \times U(L-L) \times I_p \times \cos\phi$	$P = 1.732 \times 400V \times 1000A \times 0.9 = 623520 W = 623.52 kW$	600 kW
3-phase 4-wire, voltage connection via VT (balanced or unbalanced)	$P = 3 \times U_p(L-N) \times I_p \times \cos\phi$	$P = 3 \times 5770V \times 100A \times 0.95 = 1644450 W = 1.64445 MW$	1.5 MW
3-phase 3-wire, voltage connection via VT (balanced or unbalanced)	$P = 1.732 \times U_p(L-L) \times I_p \times \cos\phi$	$P = 1.732 \times 30000V \times 50A \times 0.9 = 2338200 W = 2.3382 MW$	2.5 MW

- Select pulse rate: 1p/10kWh,
- Select output: 1 puls. o/p

### 3-phase 3-wire balanced or unbalanced

- Select type: M244-HWJ,
- Specify input voltage and CT ratio: 400V L-L, 1000/1A,
- Spec. scaling: 0-600 kW,
- Spec. frequency: 50/60Hz,
- Select pulse rate: 1p/10kWh,
- Select output: 1 puls. o/p

### 3-phase 4-wire balanced or unbalanced, VT connected

- Select type: M244-HWU,

- Specify VT ratio and CT ratio: 5770/57.7V L-N, 100/5A,
- Spec. scaling: 0-1.5 MW,
- Spec. frequency: 50/60Hz,
- Select pulse rate: 1p/100kWh,
- Select output: 1 pulsed output

### 3-phase 3-wire balanced or unbalanced

- Select type: M244-HWD,
- Specify input VT ratio and CT ratio: 30000/110V L-L, 50/1A,
- Spec. scaling: 0-2.5MW
- Spec. frequency: 50/60Hz,
- Select pulse rate: 1p/100kWh,
- Select output: 1 pulsed output





## Features

- Counts electrical reactive energy and indicates reactive power of electrical systems
- Several voltage ranges available
- Current connection via "through hole" CT on the instrument. No need to interrupt wiring from CT
- Pulsed output as standard

## Benefits

- High visibility
- Terminal cover included
- Low self consumption
- Separated power supply

## Applications

- AC switchgears, panels and distribution boards
- Control boards
- Generator sets

## Construction

- Instruments operate on a fast sampling method of input quantities (current and voltage) of the connected phases
- Meters include "through hole" CT connection, voltage dividers, internal microprocessor and power supply unit
- Slot in screw fixing

## Standards

- CE marked
- BV approved

## Order data/examples

### Single-phase

- Select type: M244-HXG,
- Specify input voltage and CT ratio: 230V L-N, 50/5A,
- Spec. scaling: 0-6kvar,
- Spec. frequency: 50/60Hz,
- Select pulse rate: 1p/10kvarh,
- Select output: 1 pulsed output

### 3-phase 4-wire balanced or 3-phase 4-wire unbalanced

- Select type: M244-HXK,
- Specify input voltage and CT ratio: 230 V L-N, 400/5A,
- Spec. scaling: 0-200kvar,

# Reactive Energy Meter with Power Indicator

## General Specification

- Accuracy class reactive power meter - 1.5
- Accuracy class reactive energy meter - 2 to EN 62053-23
- Maximum continuous overload - 2 x In, 1.2 x Un
- Nominal frequency - 50/60Hz
- Voltage burden - <0.1VA per phase
- Current burden - <0.1VA per phase
- Power supply - Various AC volts between 57.7 and 400
- Frequency - 40-65 Hz
- Voltage burden - <3 VA
- Pulsed output - 1 S0 pulsed output with 1p/10kWh, 1p/100kWh, 1p/10MWh, 1p/100MWh. Maximum pulse rate may not exceed 33 pulses per second (1980 pulses per minute). If in doubt choose next higher value, e.g. 1p/100/kWh instead of 1p/10kWh

## Product Codes

Bezel size (mm)	96	96	96	96	96
Scale length (mm)	95	95	95	95	95
Reactive energy meter with Varmeter 90°	M244-HXG single-phase	M244-HXH 3P/3W balanced	M244-HXV 3P/4W balanced	M244-HXJ 3P/3W unbalanced	M244-HXK 3P/4W unbalanced
Bezel size (mm)	96	96	96	96	96
Scale Length (mm)	135	135	135	135	135
Reactive energy meter with Varmeter 240°	M244-HXB single-phase	M244-HXC 3P/3W balanced	M244-HXU 3P/4W balanced	M244-HXD 3P/3W unbalanced	M244-HXE 3P/4W unbalanced
<b>Standard input ranges</b>					
Single-phase, 3P/4W balanced & unbalanced	57.7V L-N/1A, 57.7V L-N/5A, 63.5V L-N/1A, 63.5V L-N/5A, 230V L-N/1A, 230V L-N/5A, 240V L-N/1A, 240V L-N/5A, 254V L-N/1A, 254V L-N/5A,				
3P/3W balanced & unbalanced	100V L-L/1A, 100V L-L/5A, 110V L-L/1A, 110V L-L/5A, 400V L-L/1A, 400V L-L/5A, 415V L-L/1A, 415V L-L/5A, 440V L-L/1A, 440V L-L/5A				

## Calculation of end scale value

End scale value is calculated using the formula below, where correct voltage must be selected (either L-N or L-L), depending on the electrical system and the type of meter used. Scale factor, e.g. the relation between end scale value and nominal apparent power (cos-phi = 1) must be between 0.6 to 1.2. It is recommended selecting the scale value from 1 - 1.2 - 1.25 - 1.5 - 2 - 2.5 - 3 - 4 - 5 - 6 - 7.5 - 8 (and their decades) closest to the calculated result.

$I_p$  = CT primary current,  $U_p$  = VT primary voltage,  $U$  = direct connected voltage,  $\sin \phi$  = power factor

Electrical system	Formula	Example	End scale value to choose (considering 0.6 to 1.2 x S)
Single-phase, direct voltage connection	$P = U(L-N) \times I_p \times \sin \phi$	$Q = 230V \times 50A \times 0.44 = 5060 \text{ var} = 5.06 \text{ kvar}$	6 kvar
3-phase 4-wire, direct voltage connection (balanced or unbalanced)	$P = 3 \times U(L-N) \times I_p \times \sin \phi$	$P = 3 \times 230V \times 400A \times 0.31 = 85560 \text{ var} = 85.56 \text{ kvar}$	200 kvar
3-phase 3-wire, direct voltage connection (balanced or unbalanced)	$P = 1.732 \times U(L-L) \times I_p \times \sin \phi$	$P = 1.732 \times 400V \times 1000A \times 0.44 = 304832 \text{ var} = 304.8 \text{ kvar}$	500 kvar
3-phase 4-wire, voltage connection via VT (balanced or unbalanced)	$P = 3 \times U_p(L-N) \times I_p \times \sin \phi$	$P = 3 \times 5770V \times 100A \times 0.199 = 344469 \text{ var} = 344.469 \text{ kvar}$	1 Mvar
3-phase 3-wire, voltage connection via VT (balanced or unbalanced)	$P = 1.732 \times U_p(L-L) \times I_p \times \sin \phi$	$P = 1.732 \times 30000V \times 50A \times 0.44 = 1143120 \text{ var} = 1.14312 \text{ Mvar}$	2 Mvar

- Spec. frequency: 50/60Hz,
- Select pulse rate: 1p/10kvarh,
- Select output: 1 pul. O/P

### 3-phase 3-wire balanced or unbalanced

- Select type: M244-HXJ,
- Spec. input voltage and CT ratio: 400V L-L, 1000/1A,
- Spec. scaling: 0-500 kvar,
- Spec. frequency: 50/60Hz,
- Select pulse rate: 1p/10kvarh,
- Select output: 1 pul. O/P

### 3-phase 4-wire balanced or unbalanced, VT connected

- Select type: M244-HXU,

- Specify VT ratio and CT ratio: 5770/57.7V L-N, 100/5A,
- Spec. scaling: 0-1 Mvar,
- Spec. frequency: 50/60Hz,
- Select pulse rate: 1p/100kvarh,
- Select output: 1 pul. O/P

### 3-phase 3-wire balanced or unbalanced

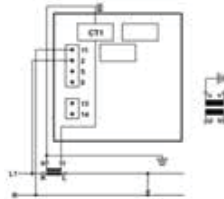
- Select type: M244-HXD,
- Specify input VT ratio and CT ratio: 30000/110V L-L, 50/1A,
- Spec.scaling: 0-2 Mvar
- Spec. frequency: 50/60Hz,
- Select pulse rate: 1p/100kWh,
- Select output: 1 pulsed O/P



## Wiring Diagrams Energy Meters

### Single-phase, direct or VT voltage connection

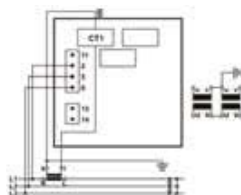
Active Energy Meter M244-HWG  
 Active Energy Meter M244-HWB  
 Reactive Energy Meter M244-HXG  
 Reactive Energy Meter M244-HXB



Power supply:  
 Terminal 13 and 14  
 Pulsed output:  
 Terminal 15 and 16

### 3-phase 3-wire balanced, direct or VT voltage connection

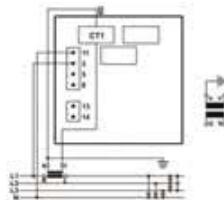
Active Energy Meter M244-HWH  
 Active Energy Meter M244-HWC  
 Reactive Energy Meter M244-HXH  
 Reactive Energy Meter M244-HXC



Power supply:  
 Terminal 13 and 14  
 Pulsed output:  
 Terminal 15 and 16

### 3-phase 4-wire balanced, direct or VT voltage connection

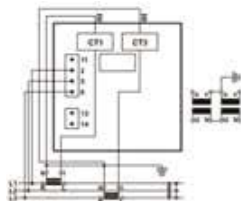
Active Energy Meter M244-HWV  
 Active Energy Meter M244-HWU  
 Reactive Energy Meter M244-HXV  
 Reactive Energy Meter M244-HXU



Power supply:  
 Terminal 13 and 14  
 Pulsed output:  
 Terminal 15 and 16

### 3-phase 3-wire unbalanced, direct or VT voltage connection

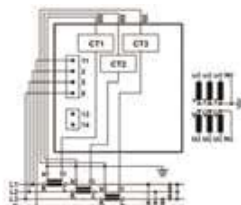
Active Energy Meter M244-HWJ  
 Active Energy Meter M244-HWD  
 Reactive Energy Meter M244-HXJ  
 Reactive Energy Meter M244-HXD



Power supply:  
 Terminal 13 and 14  
 Pulsed output:  
 Terminal 15 and 16

### 3-phase 4-wire unbalanced, direct or VT voltage connection

Active Energy Meter M244-HWK  
 Active Energy Meter M244-HWE  
 Reactive Energy Meter M244-HXK  
 Reactive Energy Meter M244-HXE



Power supply:  
 Terminal 13 and 14  
 Pulsed output:  
 Terminal 15 and 16



# INSTRUMENT SELECTOR SWITCHES

SW3-AMPS



SW6-VOLT

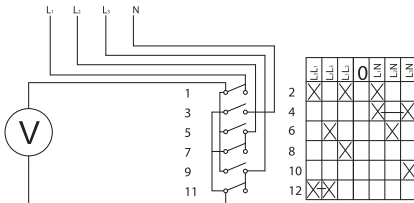


## Features

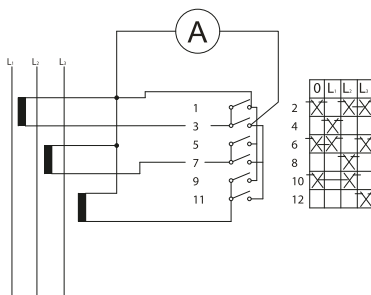
Two face plates options

## Connection Diagrams

SW6-VOLT



SW3-AMPS



Panel mounted selector switches offer a 7-position voltmeter switch and a 4-position ammeter switch for reading line-to-line or line-to-neutral voltage and phase current. Each switch is supplied with both numbered and coloured annotation.

## Specification

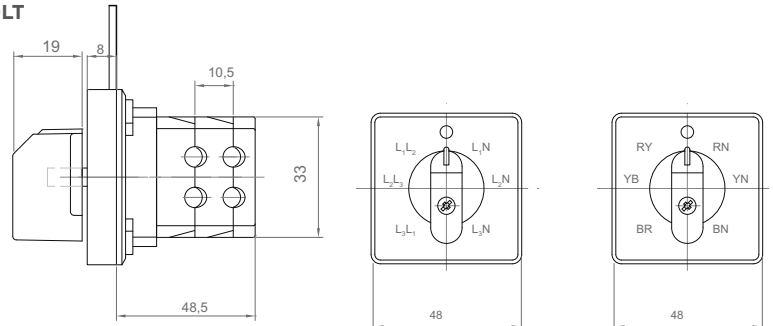
Loading capacity:	10A/500V
Switching capacity:	3.5kW at 400V, 5.5kW at 500V
Rated insulation:	500V
Rated thermal current:	10A
Operating temperature:	-20 C to +70C
Mounting installation:	2 point front fixing or 4 hole panel fixing
Dimensions front panel:	48 x 48 mm
Panel cut out:	3 drilled holes
Compliant with:	LVD and EMC EN 60947-3
IP Protection:	IP65 from front of panel, IP20 terminations
Terminal screw:	M3
Terminals, mm <sup>2</sup> :	0.5 - 2.5
Impulse withstand voltage:	4 kV
Rated short time withstand current - 1 sec:	200 A

## Product codes

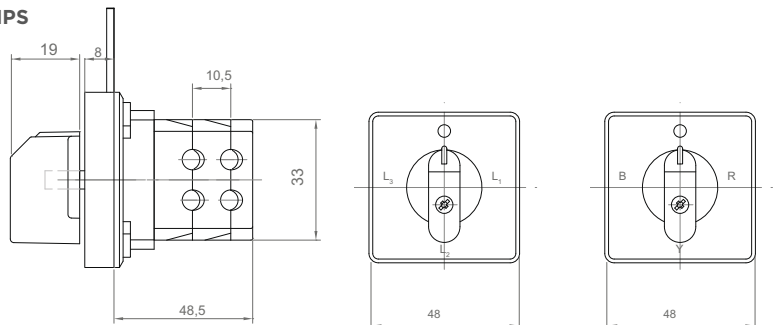
SW3-AMPS	4-position ammeter switch, with interchangeable face plate for L1,L2,L3-O and R-Y-B-O
SW6-VOLT	7-position voltmeter switch, with interchangeable face plate for L1L2,L2L3,L3L1-O-L1N-L2N-L3N and RY-YB-BR-O-RN-YN-BN

## Dimensions

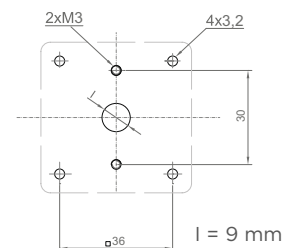
SW6-VOLT



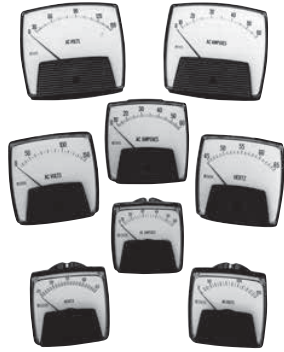
SW3-AMPS



## Panel cut-out



# SAXON SERIES PANEL INDICATORS



## Features

- Three compact case sizes
- Withstands high levels of shock, vibration, dirt and humidity
- Pivot and jewel mechanisms

## Benefits

- Complies with ANSI C39.1 (IEC 51)
- IP54 (NEMA 3) protection
- Instruments comply with BS EN61010-1 and meet IEC414 (BS5458)
- Pass dielectric test (2600V for 1min)

## Applications

- Switchgear
- Distribution systems
- Generator sets
- Control panels
- Energy management
- Building management
- Utility power monitoring
- Process control
- Motor control

## Compliant with

- UL approved file no. E203000

## Connections

See page 30

A range of 2½", 3½" and 4½" surface mount panel meters utilising pivot and jewel mechanisms and offering IP54 protection. The range includes iron vane and moving coil AC and DC ammeters and voltmeters and frequency meters designed to perform in demanding environments.

## Specifications - Frequency Meters

Accuracy:	0.15 = 60Hz, 1.25 = 400Hz, 0.15 = 50Hz, 0.25 = 55Hz
Voltage:	110/130V, 200/250V
Frequency:	50Hz or 60Hz
Burden:	4VA Maximum

## Specifications - Moving Iron AC Ammeter and Voltmeter

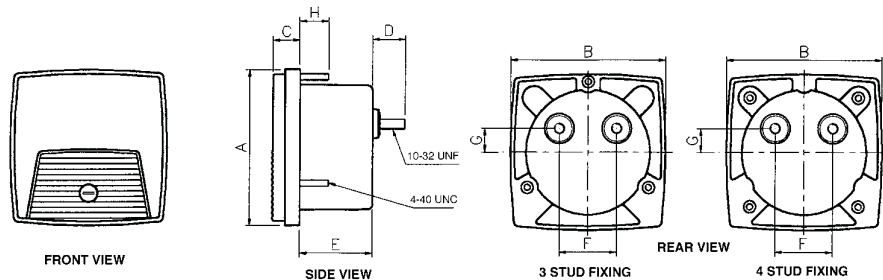
Accuracy:	±2%
Rating:	Ammeters: 1 - 30A Voltmeters: 10V - 600V
Overload:	Ammeters: x1.2 for 2 hours, x10 for 5 seconds Voltmeters: x1.2 for 2 hours, x2 for 5 seconds
Burden:	Ammeters: 0.5VA Voltmeters: 4.5VA maximum

## Specifications - Moving Coil DC Ammeter and Voltmeter

Accuracy:	±2%
Rating:	Ammeters: 1 - 30A Voltmeters: 10V - 600V
Operating temperature:	-20°C to +60°C (-4°F to +140°F)
Storage temperature:	-30°C to +70°C (-22°F to +158°F)

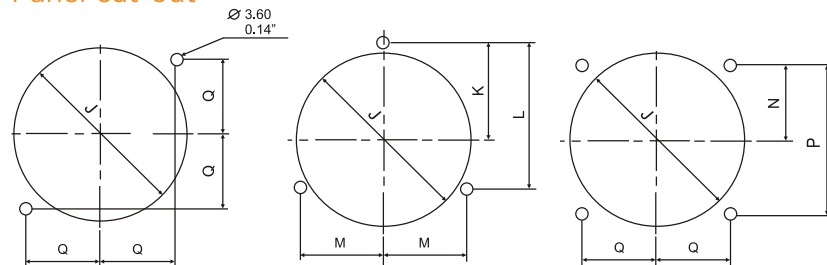
## Dimensions

Specify number of fixing studs when ordering 2½" and 3½" meters. 4½" meters are supplied with 4 fixing studs.



	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q
2½" mm	68.6	68.6	11.8	14.6	32.0	25.4	10.4	12.7	55.9	31.0	46.5	26.9	23.9	47.8	23.9
inch	2.70	2.70	0.46	0.57	1.26	1.00	0.41	0.50	2.20	1.22	1.83	1.06	0.94	1.88	0.94
3½" mm	88.9	88.9	11.8	14.6	36.0	25.4	10.4	12.7	69.9	40.2	60.3	34.8	28.5	57.0	28.5
inch	3.5	3.5	0.46	0.57	1.42	1.00	0.41	0.50	2.75	1.58	2.37	1.37	1.12	2.24	1.12
4½" mm	112.0	123.2	12.7	16.3	30.5	28.4	0.38	12.7	70.9				51.6	90.4	50.8
inch	4.41	4.85	0.50	0.64	1.20	1.12	0.41	0.50	2.78				2.03	3.56	2.00

## Panel cut-out





AC Ammeter

Product Codes - AC Ammeter True RMS Reading  
(Accuracy  $\pm 2\%$  ES)

Rating	Scaling	Cat. no.
5A	0-5A	(01*)-75AA-LSLS-C6-B*
10A	0-10A	(01*)-75AA-MTMT-C6-B*
15A	0-15A	(01*)-75AA-NDND-C6-B*
20A	0-20A	(01*)-75AA-NGNG-C6-B*
30A	0-30A	(01*)-75AA-NLNL-C6-B*
1A	Transformer rated	(01*)-75AA-LA**-C6-B*
5A	Transformer rated	(01*)-75AA-LS**-C6-B*

Product Codes - AC Voltmeter True RMS Reading  
(Accuracy  $\pm 2\%$  ES)

150V	0-150V	(01*)-75VA-PZPZ-C6-B*
300V	0-300V	(01*)-75VA-RXRX-C6-B*
600V	0-600V	(01*)-75VA-SJSJ-C6-B*
150V	Transformer rated	(01*)-75VA-PZ**-C6-B*

Product Codes - DC Ammeter (Accuracy  $\pm 2\%$  ES)

0-1mA	To suit requirements	(01*)-01AA-FA**-B*
0-5mA	0-5mA	(01*)-01AA-FXFX-B*
0-10mA	0-10mA	(01*)-01AA-GZGZ-B*
0-20mA	0-20mA	(01*)-01AA-HFHF-B*
0-50mA	0-50mA	(01*)-01AA-HYHY-B*
0-100mA	0-100mA	(01*)-01AA-JRJR-B*
0-200mA	0-200mA	(01*)-01AA-KAKA-B*
0-500mA	0-500mA	(01*)-01AA-KMKM-B*
0-1A0-1A	(01*)-01AA-LALA-B*	
0-2A0-2A	(01*)-01AA-LELE-B*	
0-5A0-5A	(01*)-01AA-LSLS-B*	
0-10A	0-10A	(01*)-01AA-MTMT-B*
0-50mV	To suit	(01*)-01AA-EC**-B*



AC Voltmeter

Product Codes - Milliammeters Suppressed Zero  
(Accuracy  $\pm 2\%$  ES)

4-20mA	To suit requirements	(01*)-01RA-HG**-B*
		**Specify scale value

Product Codes - DC Voltmeters Sensitivity 1000 $\Omega$ /Volt  
(Accuracy  $\pm 2\%$  ES)

0-15V	0-15V	(01*)-01VA-NDND-B*
0-30V	0-30V	(01*)-01VA-NLNL-B*
0-50V	0-50V	(01*)-01VA-NTNT-B*
0-150V	0-150V	(01*)-01VA-PZPZ-B*
0-300V	0-300V	(01*)-01VA-RXRX-B*
0-600V	0-600V	(01*)-01VA-SJSJ-B*

Product Codes - Frequency Meters 120V, Self Contained

50Hz	45-55Hz	(01*)-41SA-PNAG-AG-B*
55Hz	45-65Hz	(01*)-41SA-PNAJ-AJ-B*
60Hz	55-65Hz	(01*)-41SA-PNAN-AN-B*

Product Codes - Elapsed Time Meters 99999.99 hours,  
non-resettable

110/130V, 50Hz	-	(01*)-155A-PNZH-C5-B*
200/250V, 50Hz	-	(01*)-155A-RNZH-C5-B*
480V, 50Hz	-	(01*)-155A-SEZH-C5-B*
110/130V, 60Hz	-	(01*)-156A-PNZH-C6-B*
200/250V, 60Hz	-	(01*)-156A-RNZH-C6-B*
480V, 60Hz	-	(01*)-156A-SEZH-C6-B*



Frequency Meter

To denote the required case size, replace the 01\* in the catalogue number with 012, 013 or 014 for 2 1/2", 3 1/2" or 4 1/2" respectively.

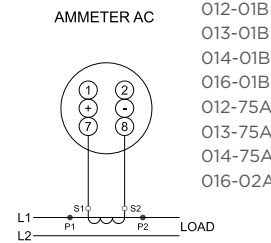
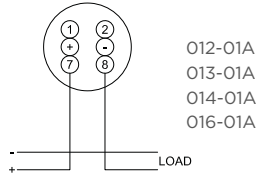
To denote the required stud fixing configuration, replace B\* with B2 (2 stud), B3 (3 stud) or B4 (4 stud).

# 016 SERIES FIESTA PANEL INDICATORS

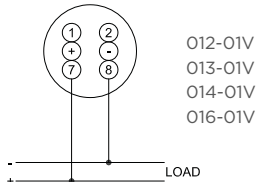


## Connections

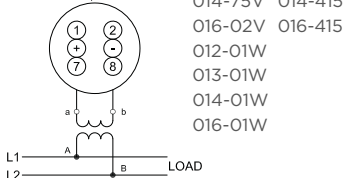
**AMMETER DC**  
Direct connected (max rating 30A)



**VOLTMETER DC**  
Direct connected (max rating 800V)



**VOLTMETER AC/  
FREQUENCY METER**  
V.T. operated



A robust range of short-scale 3½" surface mount panel meters offering IP55 protection and featuring a wide view contoured window. The Fiesta range includes iron vane and moving coil AC and DC ammeters and voltmeters, elapsed time and frequency meters and is ideally suited for demanding environments. Options include panel gasket.

## Specifications - Elapsed Time Meter and Frequency Meters

Voltage:	100/125V, 200/250V or 480V AC
Frequency:	50Hz or 60Hz
Burden:	4VA maximum
Operating temperature:	-20°C to +65°C (-4°F to +149°F)
Storage temperature:	-30°C to +70°C (-22°F to +158°F)

## Specifications - Iron Vane AC Ammeter and Voltmeter

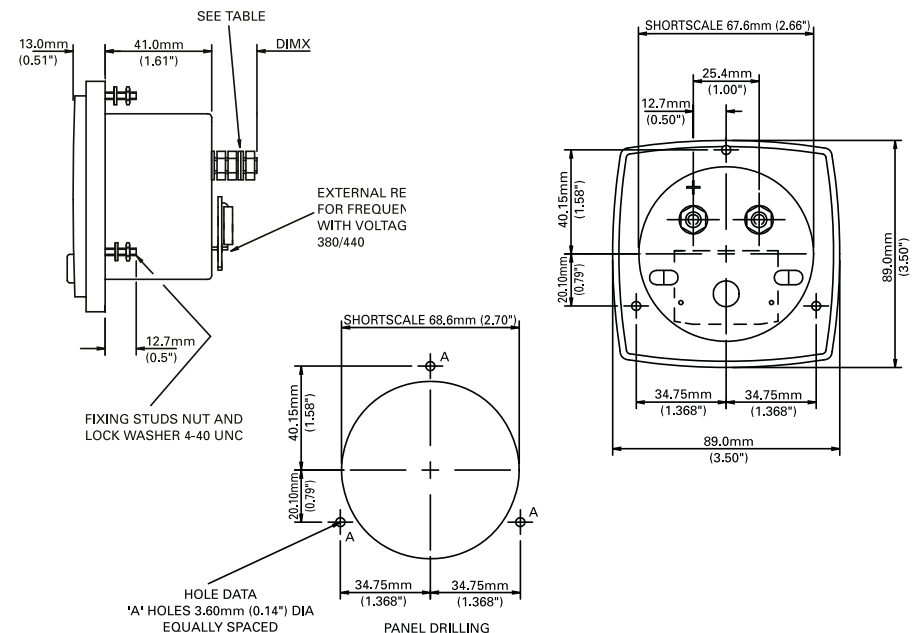
Accuracy:	Ammeters 2.5%
Ratings:	Short-scale 1 - 80A
Voltmeters:	10V - 600V
Overload:	Ammeters: x1.2 for 2 hours, 10 x for 5 seconds
Voltmeters:	x1.2 for 2 hours, 2 x for 5 seconds
Burden:	Ammeters: 0.5VA; 1.5VA
Voltmeters:	4.5VA maximum
Operating temperature:	-20°C to +65°C (-4°F to +149°F)
Storage temperature:	-30°C to +70°C (-22°F to +158°F)

## Specifications - Moving Coil DC Ammeter and Voltmeter

Accuracy:	1.5
Ratings:	Ammeters: 100µA to 30A
Voltmeters:	50mV - 600V
Overload:	Ammeters: x1.2 for 2 hours, 10 x for 5 seconds
Voltmeters:	x1.2 for 2 hours, 2 x for 5 seconds
Impedance:	Voltmeters: 1000 ohms per nominal volt
Operating temperature:	-20°C to +65°C (-4°F to +149°F)
Storage temperature:	-30°C to +70°C (-22°F to +158°F)

## Dimensions

Instrument	Dim X inches	Dim X mm
MC. INSTS	1/4"-28 UNF	18.0
MI voltmeter and AMM up to 59A	1/4"-28 UNF	18.0
MI ammeter 60A and over	5/16"-24 UNF	23.0





AC Ammeter Short-scale



AC Overload Ammeter



AC Voltmeter

## AC Ammeter

Product Codes – True RMS Reading, Self Contained 50/60Hz

Rating	Scaling	Cat. no.
5A	0-5A	•016-02A*-LMLS-C7
10A	0-10A	•016-02A*-MTMT-C7
15A	0-15A	•016-02A*-NDND-C7
20A	0-20A	•016-02A*-NGNG-C7
30A	0-30A	•016-02A*-NLNL-C7
5A	Transformer rated	•016-02A*-LS**-C7

Product Codes - Moving Coil Rectified

100µA - 1A	To suit	•016-01B*-
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## AC Overload Ammeter

Product Codes – True RMS Reading, Self Contained 50/60Hz

Rating	Scaling	Cat. no.
5A	0-5-30A	•016-026*-LMLS-C7
10A	0-10-60A	•016-026*-MTMT-C7
15A	0-15-90A	•016-026*-NDND-C7
20A	0-20-120A	•016-026*-NGNG-C7
30A	0-30-180A	•016-026*-NLNL-C7
5A	Transformer rated	•016-026*-LS**-C7

## AC Voltmeter

Product Codes – True RMS Reading

Rating	Scaling	Cat. no.
150V	0-150V	•016-02V*-PZPZ-C7
300V	0-300V	•016-02V*-RXRX-C7
600V	0-600V	•016-02V*-SJSJ-C7
150V	Transformer rated	•016-02V*-PZ**-C7

Product Codes - Moving Coil Rectified

15-600V	To suit	•016-01W*-
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## DC Ammeters

Product Codes

Rating	Scaling	Cat. no.
0-50mV	To suit	•016-01A*-EC**
0-1mA	To suit	•016-01A*-FA**
0-5mA	To suit	•016-01A*-FX**
0-10mA	To suit	•016-01A*-HA**
0-20mA	To suit	•016-01A*-HF**

## Suppressed Zero

Product Codes - Milliammeters - No Zero Set Unless Specified

Rating	Scaling	Cat. no.
4/20mA	To suit	•016-01RA*-HG**

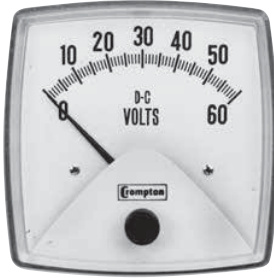
Product Codes - Voltmeter - No Zero Set Unless Specified

1-5V	To suit	016-01S*-LM**
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\* Please state A or B at time of ordering. A = ANSI B = BS89

\*\* Customer must state required scaling at time of ordering.

• UL approved



DC Voltmeter



Frequency Meter



Elapsed Time Meter

## DC Voltmeters

Product Codes – Sensitivity 1000Ω/V

Rating	Scaling	Cat. no.
0-15V	0-15V	•016-01V*-NDND
0-30V	0-30V	•016-01V*-NLNL
0-50V	0-50V	•016-01V*-NTNT
0-150V	0-150V	•016-01V*-PZPZ
0-300V	0-300V	•016-01V*-RXRX
0-600V	0-600V	•016-01V*-SJSJ

## Frequency Meters

Product Codes – 120V, Self Contained

Rating	Scaling	Cat. no. standard case
50Hz centre frequency, -0.15 accuracy	45-55Hz	•016-41S*-PNAG-AG
55Hz centre frequency, -0.25 accuracy	45-65Hz	•016-41S*-PNAJ-AJ
60Hz centre frequency, -0.15 accuracy	55-65Hz	•016-41S*-PNAN-AN
400Hz centre frequency, -1.25 accuracy	360-440Hz	•016-41S*-PNBI-BI

## Elapsed Time Meters

Product Codes – 99999.99 hours, Non-resettable

Rating	Scaling	Cat. no. standard case
110/130V, 50Hz	-	•016-155*-PNZH-C5
200/250V, 50Hz	-	•016-155*-RNZH-C5
480V, 50Hz	-	•016-155*-SEZH-C5
110/130V, 60Hz	-	•016-156*-PNZH-C6
200/250V, 60Hz	-	•016-156*-RNZH-C6
480V, 60Hz	-	•016-156*-SEZH-C6

## Transducer Indicators

Product Codes – DC Milliamp Rated

Rating	Scaling	Cat. no. standard case
Speed	To suit	016-012*
Frequency	To suit	016-013*
Phase angle	To suit	016-014*
Watts	To suit	016-015*
VArs	To suit	016-016*
VA	To suit	016-017*

\* Please state A or B at time of ordering. A = ANSI B = BS89

\*\* Customer must state required scaling at time of ordering.

• UL approved



# CHALLENGER ANALOGUE PANEL METERS



## Features

- Measurement and indication of AC amps, volts, frequency and DC signals
- Surface or window mounting
- Rear zero adjuster on moving coil meters
- High torque pivot and jewel movement
- True RMS measurement meters
- AC and DC inputs
- Up to 40A DC direct connected
- Up to 50A AC direct connected

## Benefits

- AC moving iron and moving coil mechanisms
- Reduced inventory
- 4 ANSI standard case sizes
- Detachable lower fascia plate
- Easy to modify for distributors
- Through holes for back of panel mounting

## Applications

- Marine panels
- Switchgear
- Distribution systems
- Control panels
- Embedded generation
- Energy management
- Building management
- Utility power monitoring
- Process control
- Motor monitoring

## Compliant with

- ANSI C39.1 1981
- IEC 51
- UL3111-1
- EMC
- LVD
- UL and CUL file no: E236986

The Challenger range of analogue panel meters offers accurate measurement and indication of most electrical and electronic parameters in industry standard 1½", 2½", 3½" and 4½" case sizes. This innovative design features a detachable lower fascia plate, which allows the flexibility of either surface or window mounting. The fascia is simply unclipped to achieve the completely flush panel appearance of rear of panel window mounting.

The range offers AC and DC ammeters, voltmeters and frequency meters utilising a high torque pivot and jewel movement. AC moving coil rectified meters provide 1.5% accuracy of the full scale value and feature a rear zero adjuster screw for tamperproof installation. AC moving iron meters also provide 1.5% high accuracy and true RMS measurement.

## Operation

The Challenger analogue panel meters utilise a traditional pivot and jewel movement, incorporating specially hardened steel pivots and a spring loaded jewel. This robust mechanism is ideally suited for all applications, including the most demanding conditions.

## Moving Coil Meters

These meters offer a centre cored, self-shielding moving coil movement using pivots, hairsprings and sprung jewels. Variations in movement are limited by design. All DC voltmeters are 1000 ohms per Volt, moving coil rectified products run at 900 ohms per Volt. Millivolt meters use a 5 milliamps/50mV movement.

## Moving Iron Meters

This clapper type repulsion design utilises a pivot, hairspring and jewel movement. The bottom jewel is oil filled to provide damping while the top is sprung for resilience. All voltmeters are manufactured with internal voltage dropper resistors.

## Frequency Meters

Frequency meters utilise a 1mA/35 ohm DC moving coil movement driven by an EMC hard frequency conversion circuit.

## Dials, Pointers and Scales

Standard dials are matt white with black printed scales and a tubular knife-edge black matt pointer. The 90° scales are balanced within 1% of scale length and feature a highly repeatable flattened arc scale shape, ensuring consistently accurate measurement readings. Dials are interchangeable between the Challenger meters for inputs within the published specifications of the meter. Options for non standard customised dials are available upon request.

## Current Transformers and Shunts

Crompton Instruments, a Business Unit of TE Connectivity Ltd, offers a comprehensive range of current transformers and shunts, for driving the Challenger panel meters for the safe and simple measurement of AC and DC currents.

Our extensive range of current transformers provides accurate measurement of AC current and ratio matching to a consistent 5 or 1 amp secondary current, proportional to the primary current.

Our range of shunts ensures a DC millivolt signal exactly proportional to the system current for driving ammeters, providing accurate measurement of DC current up to 12000A, with secondary inputs of, 50, 60, 75 or 100mV DC to match the Challenger input.



Model 361 (1 1/2")



Model 362 (2 1/2")



Model 363 (3 1/2")



Model 364 (4 1/2")

## Specifications

<b>Accuracy</b>	
DC ammeters and voltmeters:	1.5% 0-100% of full scale deflection
AC ammeters and voltmeters:	Moving iron: 1.5% 10-100% of full scale deflection Moving coil: 1.5% 10-100% of full scale deflection
Frequency meters:	0.5% of end scale value
<b>Input ratings</b>	
DC moving coil ammeters:	50µA - 40A DC. (Model 361: 10A max)
DC moving coil voltmeters:	50mV - 600V DC
DC moving coil centre zero ammeters:	+/-50mA to +/-40A DC. (Model 361: 10A max)
DC moving coil centre zero voltmeter:	+/-50mV to +/-600V DC. Standard 1k ohm/volt
DC moving coil suppressed zero ammeters:	4/20mA DC
DC moving coil suppressed zero voltmeters:	1/5, 8/16, 16/32 or 12/24V DC
AC moving coil ammeters:	100µA - 750mA AC
AC moving coil voltmeters:	20 - 600V AC. Standard 900 ohms/volt
AC moving iron ammeters:	1 - 50A AC (Model 361: non applicable)
AC moving iron voltmeters:	3 - 600V AC (Model 361: non applicable)
Frequency:	100/130V, 200/250V, 360/440V, 50Hz, 60Hz or 400Hz (Model 361: non applicable)
Burden:	Ammeter: 0.5VA Voltmeter: 4.5VA
Frequency:	4VA
Overload:	1.2 continuous x 10 for 0.5 seconds
<b>Enclosure</b>	
Movement:	High torque pivot and jewel moving coil and moving iron
Scale balance:	Within 1% of scale length
Relative humidity:	25% - 80% nominal range of use
Operating temperature:	0°C to +40°C (-32°F to +104°F)
Storage temperature:	-20°C +55°C (-4°F to +131°F)
Case and lower mask:	Black matt case UL94V. Polycarbonate cover
Window:	Shatterproof polycarbonate
Surface mounting:	4 corner studs
Rear of panel mounting:	2 through hole mounts (Model 361: facility pending)
<b>Compliant with</b>	
UL and CUL:	61010B-1 File no: E236986
Performance:	ANSI C39.1 1981 and IEC 51
Scaling:	ANSI C39.1 1981
Safety:	IEC61010-1 (LVD) and BS EN61326:1998 (EMC)
Vibration:	ANSI C39.1 1981 cl. 5.13

## Product Codes

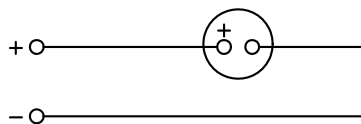
Input	Model 361 cat. no.	Model 362 cat. no.	Model 363 cat. no.	Model 364 cat. no.
DC moving coil amps	361-01A	362-01A	363-01A	364-01A
DC moving coil volts	361-01V	362-01V	363-01V	364-01V
DC moving coil centre zero amps	361-01C	362-01C	363-01C	364-01C
DC moving coil centre zero volts	361-01N	362-01N	363-01N	364-01N
DC moving coil suppressed zero amps	361-01R	362-01R	363-01R	364-01R
DC moving coil suppressed zero volts	361-01S	362-01S	363-01S	364-01S
AC moving coil amps	361-01B	362-01B	363-01B	364-01B
AC moving coil volts	361-01W	362-01W	363-01W	364-01W
AC moving iron amps	N/A	362-02A	363-02A	364-02A
AC moving iron volts	N/A	362-02V	363-02V	364-02V
Frequency	N/A	362-41S	363-41S	364-41S

Please specify current, voltage, frequency and required options at time of ordering.

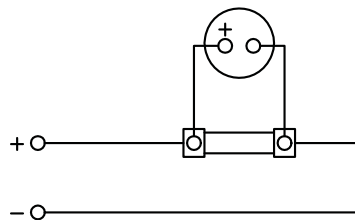


## Connections

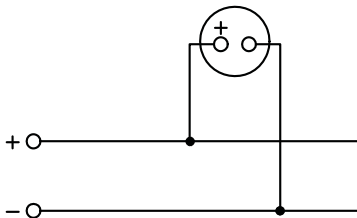
DC Amps - Self contained



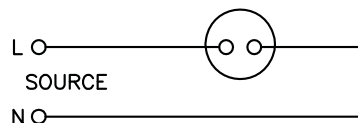
DC Amps - For use with external shunt



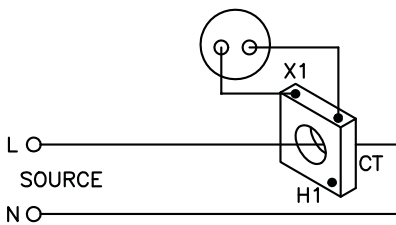
DC Volts



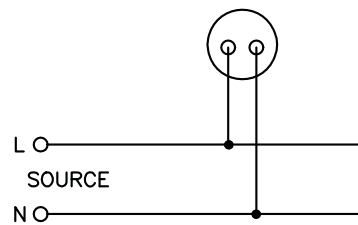
AC Amps - Self contained



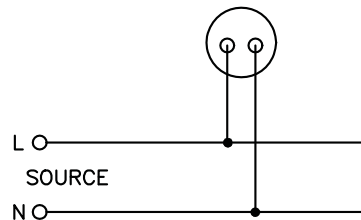
AC Amps - For use with current transformer



AC Volts

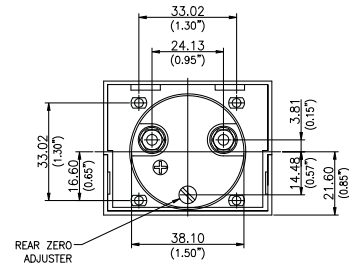
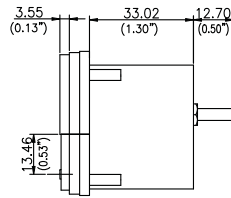
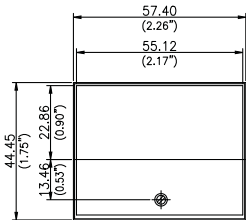


Frequency Meter

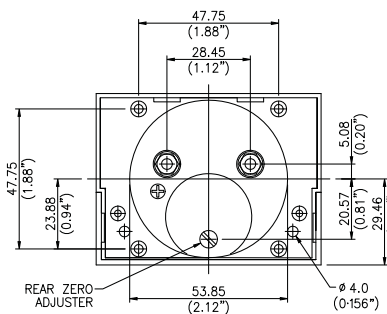
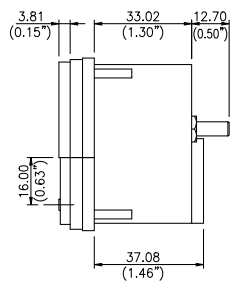
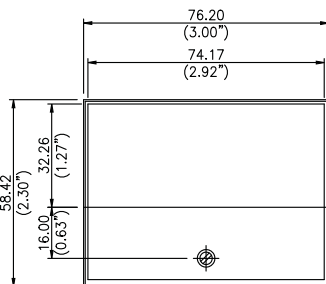


## Dimensions - Surface Mount

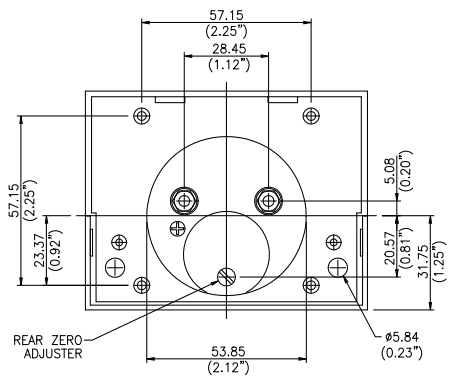
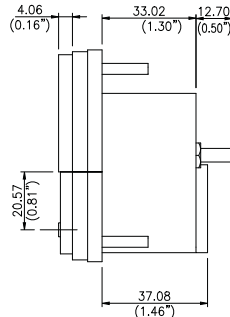
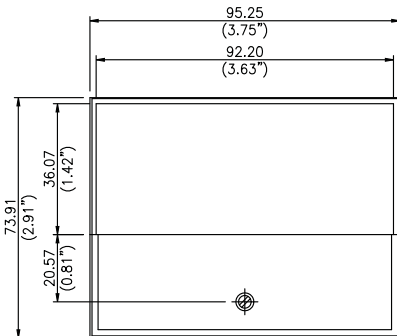
### Model 361



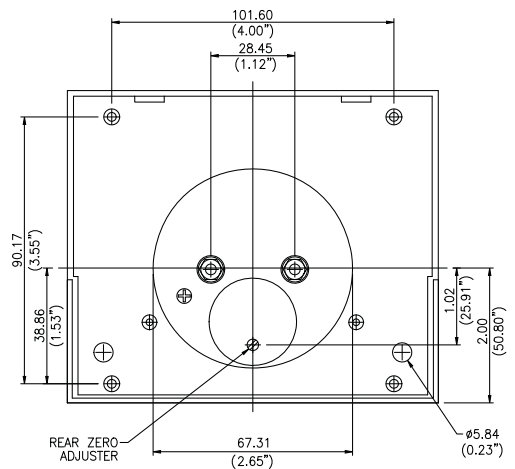
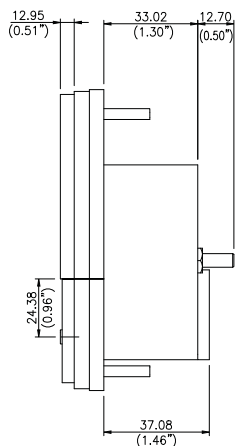
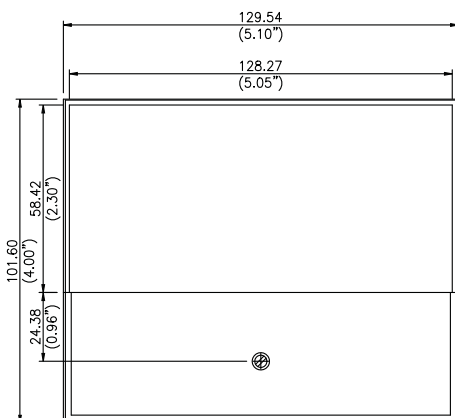
### Model 362



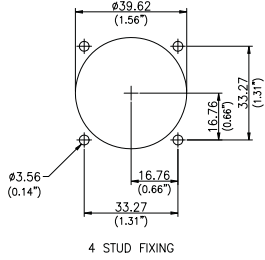
### Model 363



### Model 364

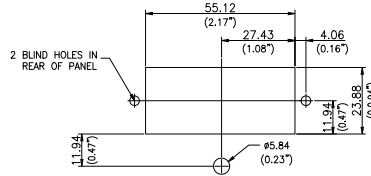


**Model 361**  
Surface Mount Cut-out



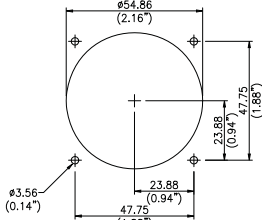
4 STUD FIXING

**Window Mount Cut-out**



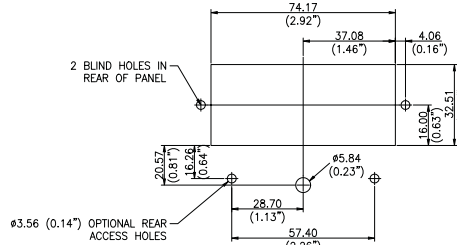
PANEL CUT-OUT FOR WINDOW MOUNTING

**Model 362**  
Surface Mount Cut-out



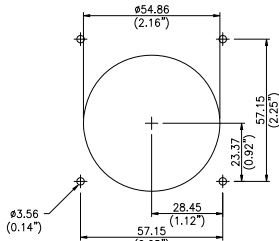
4 STUD FIXING

**Window Mount Cut-out**



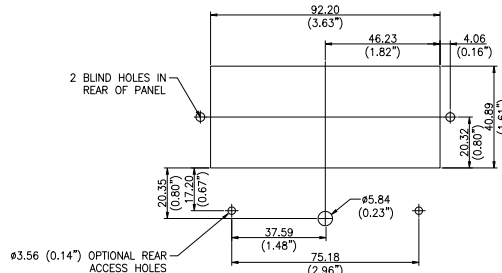
PANEL CUT-OUT FOR WINDOW MOUNTING

**Model 363**  
Surface Mount Cut-out



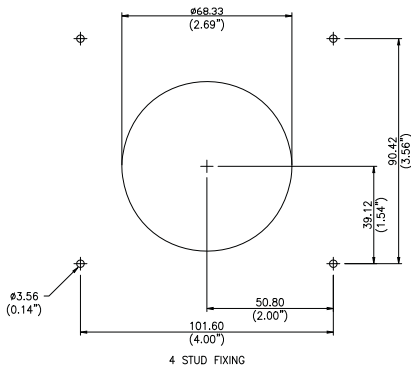
4 STUD FIXING

**Window Mount Cut-out**



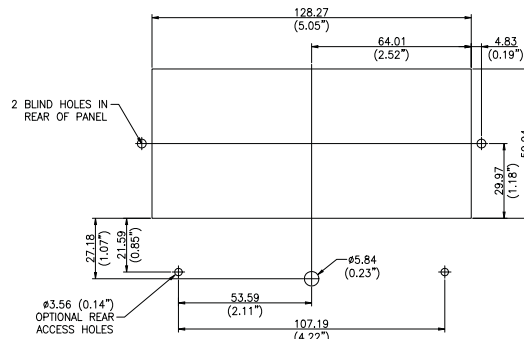
PANEL CUT-OUT FOR WINDOW MOUNTING

**Model 364**  
Surface Mount Cut-out



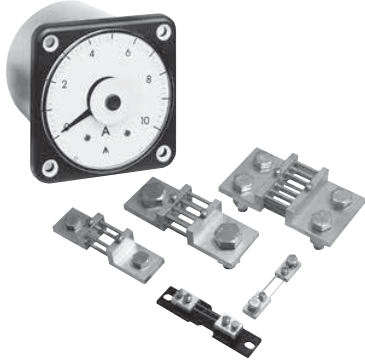
4 STUD FIXING

**Window Mount Cut-out**



PANEL CUT-OUT FOR WINDOW MOUNTING

# SEALED AND RUGGEDISED PANEL INDICATORS



## Features

- Designed specifically for stringent industrial, marine and military specifications
- An extensive range of high accuracy measuring instruments in 3 case sizes
- Rugged Hi-Q taut-band suspension
- Bump, shock and vibration proof

## Benefits

- Complies with BS EN60051 (IEC51)
- IP67 (NEMA 6 and 6P) protection
- Dial illumination option
- Parallax error-free platform dials for 078/087. Optional for 083/084

## Applications

- Switchgear
- Distribution systems
- Generator sets
- Control panels
- Utility power monitoring
- Process control
- Motor control
- Marine
- Military

## Approvals

- DEF STAN 66.7

## 078/080/087 Series 240° Scale

The Crompton Instruments 078/080/087 series of heavy duty sealed instruments are designed to comply with the most stringent industrial, marine and military specifications.

This metal cased range offers bezel sizes of 57mm, 83mm and 110mm all fitted with toughened glass. Indicators comply with Ministry of Defence specification DEF STAN 66.7. and operate efficiently in the most adverse environments where extreme conditions of shock, vibration, dirt, humidity and temperature variation are present.

## Description

Indicators have metal cases with bezel sizes of 50 x 57mm (083), 83mm Ø (084) and 110mm x 100mm (078/087). All indicators are fitted with toughened glass windows. The standard black matt finish can be replaced with options ranging from light admiralty grey to BS3181C No:697. To prevent fogging, all indicators have been dried, evacuated and filled with dry nitrogen during manufacturing. The case interior retains a constant pressure of at least 94kPa above the exterior with leakage not above the equivalent of 1.33 Pa ml/s of air. Except on model 083, panel sealing gaskets are standard equipment.

Standard instrument dials are finished in acrylic white matt with black printing and a parallel pointer. Scales form a true arc with zero on the left hand-side. Options include dial illumination, a centre, off-set or suppressed zero, colour index lines, bands, zones or segments, a black dial with white printing, and customer logo.

## Specifications

Performance:	BS EN60051 (IEC51) DEF STAN 66-7 on request (087 only)
Accuracy:	Refer to Product Range table
Scaling:	BS89, BS3693 or DEF STAN 66-7 and 66-9
Dielectric test:	2kV RMS to BS EN61010-1
Overloads:	x 1.2 rated current for 2 hours x 10 rated current for 5 seconds x 1.2 rated voltage for 2 hours x 2 rated voltage for 5 seconds
Enclosure code:	IP67 (NEMA 6 and 6P)
Case:	Black matt metal filled with dry nitrogen
Bezel:	Black matt metal. Optional admiralty grey No. 697
Bezel window:	Toughened glass
Operating temperature:	-40°C to +70°C (-40°F to +158°F)
Storage temperature:	-55°C to +85°C (-67°F to +185°F)
Standard calibration:	23°C (73°F)
Approvals:	EMC and LVD DEF 66.7



## 078/080/087 Series 240° Scale

### Product Range

Type of instrument	Ranges	Accuracy class	Burden VA	Case code depth behind the bezel				Product code
DC ammeter shunt operated	50, 60, 75, 100, 150mV	2.5	See T118***	57	-	-	-	083-05A
DC ammeter shunt operated	50, 60, 75, 100, 150mV	1.5	See T118***	-	59	-	-	084-05A
DC ammeter shunt operated	50, 60, 75, 100, 150mV	1.5	See T118***	-	-	86	-	078-05A
DC ammeter shunt operated	50, 60, 75, 100, 150mV	1.5	See T118***	-	-	-	86	087-11A
DC ammeter	200QA-30A	2.5	See T118***	57	-	-	-	083-05A
DC ammeter	200QA-30A	1.5	See T118***	-	59	-	-	084-05A
DC ammeter	200QA-30A	1.0	See T118***	-	-	86	-	078-05A
DC ammeter	200QA-30A	1.0	See T118***	-	-	-	86	087-11A
DC ammeter suppressed zero	4/20mA	2.5	See T118***	57	-	-	-	083-05R
DC ammeter suppressed zero	4/20mA	1.5	See T118***	-	59	-	-	084-05R
DC ammeter suppressed zero	4/20mA	1.5	See T118***	-	-	86	-	078-05R
DC ammeter suppressed zero	4/20mA	1.5	See T118***	-	-	-	86	087-11R
DC voltmeter	50mV-600V	2.5	See T118***	57	-	-	-	083-05V
DC voltmeter	50mV-600V	1.5	See T118***	-	59	-	-	084-05V
DC voltmeter	50mV-800V	1.5	See T118***	-	-	86	-	078-05V
DC voltmeter	50mV-800V	1.0	See T118***	-	-	-	86	087-11V
DC voltmeter suppressed zero	1/5V	1.5	See T118***	-	-	86	-	078-05S
DC voltmeter suppressed zero	1/5V	1.5	See T118***	-	-	-	86	087-11S
AC rectified ammeter	200QA-1A	2.5	See T118***	57	-	-	-	083-05B
AC rectified ammeter	200QA-1A	2.5	See T118***	-	59	-	-	084-05B
AC rectified ammeter	200QA-30A	1.5	See T118***	-	-	86	-	078-05B
AC rectified ammeter	200QA-30A	1.5	See T118***	-	-	-	86	087-11B
AC rectified voltmeter	15-600V 25Hz/3kHz	2.5	See T118***	57	-	-	-	083-05W
AC rectified voltmeter	15-600V 25Hz/3kHz	2.5	See T118***	-	59	-	-	084-05W
AC rectified voltmeter	15-600V 25Hz/3kHz	1.5	See T118***	-	-	86	-	078-05W
AC rectified voltmeter	15-600V 25Hz/3kHz	1.5	See T118***	-	-	-	86	087-11W
Elapsed time meter	50 or 60Hz, 100-400V*			57	-	-	-	083-155 or 156
Elapsed time meter	12, 24V DC			57	-	-	-	083-151
Elapsed time meter	50 or 60Hz, 100-400V*			-	59	-	-	084-155 or 156
Elapsed time meter	12, 24V DC			-	59	-	-	084-151
Elapsed time meter	50 or 60Hz, 100-400V*			-	-	86	-	078-155 or 156
Frequency meter	50/60/400Hz 100-440V*	0.5%	4	57	-	-	-	083-41S
Frequency meter	50/60/400Hz 100-440V*	0.5%	4	-	59	-	-	084-41S/089-41S
Frequency meter	50/60/400Hz 100-440V*	0.5%	4	-	-	86	86	078/087-41L
Temperature indicator	RTD	1.5	See T118***	-	-	86	-	078-45 R
Wattmeter or Varmeter	0.2-10A/100-440V*	Balanced	Current	-	-	132	132	078/087-21 or 31
Transducer operated indicator	1, 5, 10, 20 or 4/20mA	1.0	See T118***	57	-	-	-	083-05
Transducer operated indicator	1, 5, 10, 20 or 4/20mA	1.0	See T118***	-	59	-	-	084-05
Transducer operated indicator	1, 5, 10, 20 or 4/20mA	1.0	See T118***	-	-	86	-	078-05
Transducer operated indicator	1, 5, 10, 20 or 4/20mA	1.0	See T118***	-	-	-	86	087-11

\* 100-440V = (100/125, 200/250, 380/440).

\*\*\* The T118 technical sheet is available on request.



## O80 Series 90° Scale

A range of metal case, sealed instruments for industrial and military applications involving extreme shock, vibration, temperature, dirt and humidity. Bezel sizes 57mm, 83mm comply with Ministry of Defence specification DEF STAN 66-7 or DEF STAN 66-9 for all standard ratings.

### Description

Two bezel sizes of 57 x 57mm (O83) and 83mm Ø (O84), with barrel diameters of 53mm (O83) and 67mm (O84) and toughened glass windows are used throughout the series. To avoid fogging they are dried, evacuated and filled with dry nitrogen. Panel sealing gaskets are provided as standard with the exception of Model O83. Models O83 and O84 have steel cases with fixing holes in the flange. Sealed zero adjusters are provided. Standard instrument dials are finished in a white matt with black printing and parallel pointer. The scales form a true arc with zero on the left.

### Options

Available options include dial illumination, a centre, off-set or suppressed zero, colour index lines, bands, zones or segments, a black dial with white printing and customer logo. Instruments operated by separate transducers indicate watts, VAR, frequency, phase angle, current, voltage and other physical/mechanical parameters are also available. Illumination options as follows:

Models O83/O84: Edge, white or red bulb, 12 or 24V, illumination.

## Specifications

Performance:	BS EN60051 (IEC51). DEF STAN 66-7 and 66.9 on request (O84 only)
Accuracy:	Class 2.5 frequency meter 0.5% of mid frequency
Scaling:	To BS89, BS3693 or DEF STAN 66-7 and 66-9
Dielectric test @ 50 Hz:	2kV RMS; <50V 500V RMS All for 1 minute
Overloads:	x1.2 rated current or voltage for 2 hours. x 10 rated current for 5 seconds. x2 rated voltage for 5 seconds
Burden:	AC ammeter: 1VA maximum. AC voltmeter: 3VA maximum
Frequency meter:	4VA maximum
Elapsed time meter:	2.5VA maximum
Enclosure code:	IP67 (NEMA 6 and 6P)
Case:	Black matt metal filled with dry nitrogen
Bezel:	Black matt metal
Bezel window:	Toughened glass
Operating temperature:	-40°C to +70°C (-45F to +158°F)
Standard calibration:	23°C (73°F)
Approvals:	EMC and LVD. DEF 66.7 and 66.9

## Product Range

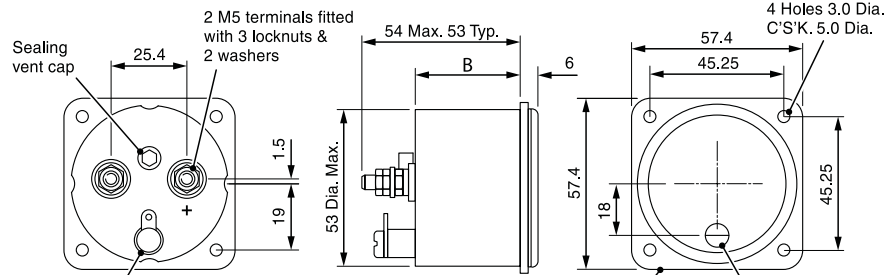
Type of instrument	Ranges	Case code		Product code
AC ammeter moving iron	1-30A	✓	-	O83-75A
AC ammeter moving iron	1-30A	-	✓	O84-75A
AC voltmeter moving iron	5-300V	✓	-	O83-75V
AC voltmeter moving iron	5-300V	-	✓	O84-75V
DC ammeter shunt operated	50, 60, 75, 100, 150mV	✓	-	O83-80A
DC ammeter shunt operated	50, 60, 75, 100, 150mV	-	✓	O84-80A
DC ammeter	50QA-30A	✓	-	O83-80A
DC ammeter	50QA-30A	-	✓	O84-80A
DC ammeter suppressed zero	4/20mA	✓	-	O83-80R
DC ammeter suppressed zero	4/20mA	-	✓	O84-80R
DC voltmeter	50mV-300V, 1000Ω/V	✓	-	O83-80V
DC voltmeter	50mV-300V	-	✓	O84-80V
DC voltmeter suppressed zero	1/5V	-	✓	O84-80S
AC rectified ammeter	100QA-500mA.25Hz/3kHz	✓	-	O83-80B
AC rectified ammeter	100QA-500mA.25Hz/3kHz	-	✓	O84-80B
AC rectified voltmeter	15-600V, 900Ω/V	✓	-	O83-80W
AC rectified voltmeter	15-600V	-	✓	O84-80W
Elapsed time meter (99999.9)	12 or 24V DC	✓	✓	O82/O83/O84-151
Elapsed time meter (99999.9)	50Hz/100-440V*	✓	✓	O83/O84-155
Elapsed time meter (99999.9)	60Hz/100-440V*	✓	✓	O83/O84-156
Frequency meter	50 or 60 or 400Hz/100-440V*	✓	-	O83-41S
Frequency meter	50 or 60 or 400Hz/100-440V*	-	✓	O84-41S
Transducer indicator speed	1, 5, 10, 20, and 4/20mA	-	✓	O84/802
Transducer indicator frequency	1, 5, 10, 20, and 4/20mA	-	✓	O84/803
Transducer indicator phase angle	1, 5, 10, 20, and 4/20mA	-	✓	O84/804
Transducer indicator watts	1, 5, 10, 20, and 4/20mA	-	✓	O84/805
Transducer indicator VARs	1, 5, 10, 20, and 4/20mA	-	✓	O84/806
Transducer indicator VA	1, 5, 10, 20, and 4/20mA	-	✓	O84/807

\*100-440V - (100/125 or 200/250 or 380/440).



## Dimensions

### Model 083

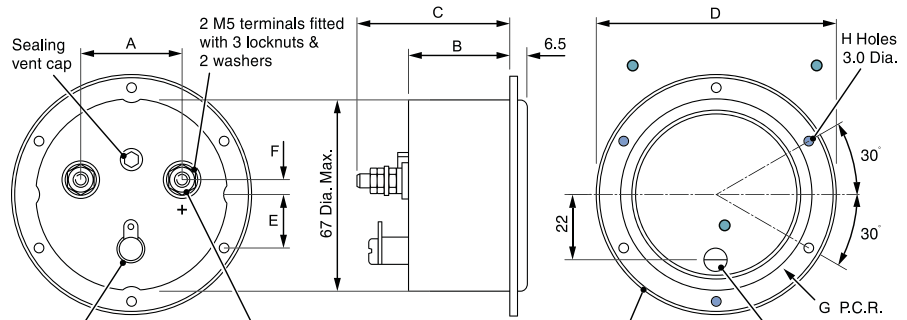


Earthing terminal (fitted with connection tab, spring washer, M4 x 6 pan head screw.)

Mild steel case & base. Case finished in semi-gloss black stove enamel.

B	
083-80	33.6
083-75	37.6

### Model 084



Earthing terminal (fitted with connection tab, spring washer, M4 x 6 pan head screw.)

Positive terminal denoted by red collar or position mark on D.C. instruments.

Mild steel case & base. Case finished in semi-gloss black stove enamel.

\*When fitted with terminal shunt for ranges above 20 amps.

	A	B	C	D	E	F	G	H
084-80	35	33.5	59	82.5	20	5	36.5	6 off
084-75	35	38	64	82.5	20	5	36.5	6 off

Panel Cut out 68.3ø - Holes 3.8ø

These ● holes on 084 only.

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## About TE Connectivity

TE Connectivity is a global, \$14 billion company that designs and manufactures over 500,000 products that connect and protect the flow of power and data inside the products that touch every aspect of our lives. Our nearly 100,000 employees partner with customers in virtually every industry – from consumer electronics, energy and healthcare, to automotive, aerospace and communication networks – enabling smarter, faster, better technologies to connect products to possibilities.

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